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Satish Sharma, Mikhail Shebalkov, Andrey Yukhanaev

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EVALUATING BANKS PERFORMANCE USING KEY FINANCIAL INDICATORS – A QUANTITATIVE MODELING OF RUSSIAN BANKS

Satish Sharma
Northumbria University, UK
Mikhail Shebalkov
Alfa Bank, Russia
Andrey Yukhanaev
Northumbria University, UK

ABSTRACT

Since the financial crisis of 2008, risk based performance management has been one of the important indicator to determine the financial health of banks and financial institutions. This study relates to the problem within the Russian Banking sector for regulators to determine and reduce risks at the marco-level and assessing performance of banks at the micro-level. The objectives are: to analyse a range of performance indicators and to structure the Russian banking sector. To explore the structure of Russian Banking sector in terms of performance over the period 2000-2010, we took a sample of 1279 banks and the financial data which was in the HTML format was extracted through PHP programming. With the help of trend analysis, the period 2000-2010 was divided into four sub periods: the period of stabilization (2002-2004), substantial development (2004-2007), financial crisis (2007-2009) and moderate development (2009-2010). Multivariate analysis were applied to classify the sample banks in these sub periods which provides evidence that despite the changes in the stage of development of the economy, the Russian Banking sector can be described with quantitative modeling. Naturally, the structural changes are affected by the described economic cycles, but these changes do not affect the determination capabilities of the model. In the period 2002-2004, nine types of banks are found. There are some prosperous as well as weak banks. During the period 2004-2007, banks had a chance to increase their profits; the banking sector became more differentiated – 12 clusters are singled out. There is no doubt that the financial crisis also affected the banking industry; there were still 12 clusters in 2007-2009, but the majority were concentrated into a single cluster with low performance indicators. Finally, the Russian banking sector started its development in the period 2009-2010, uniting some bank clusters, 10 groups are found. The results indicated that through mathematical modelling, Russian banks could be rated as "rating groups" based on their performance which might be of particular interest to bank's managers, investors, credit analysts and bank regulators. Moreover, it could be emphasized that the changes in structure are not significant, as certain groups of banks can be found at any period of time. These groups or clusters can be referred to certain "rating groups" (from the banks with the best results to those with low results) and compared to international ratings.

JEL Classifications: G17, G21, G32
Keywords: Banks, Performance, Multivariate Analysis
Corresponding Author's Email Address: s.sharma@northumbria.ac.uk

INTRODUCTION

The credit crisis of 2008 has shown that banks and financial institutions are vulnerable and their failures would endanger the world economic system with serious consequences. Thus, it is imperative for governments, regulators and market participants to modify their strategies and structures in response to ensure that the impact of the next crisis is minimised (Choudhry, 2011). Modernization of the Russian banking sector cannot be successful without close interaction between economics and mathematical methods of research. The in-depth analysis of the Russian banking sector will help the regulators to reduce risks at the macro level, e.g. improving legislation for different groups of banks. Moreover, it will provide banks' clients with a tool to assess banks' reliability and performance at the micro level.

This study aims to deliver application of a mathematical modelling approach in analysing the Russian banking sector by structuring the banking sector which would enhance performance and shield against the risk of failure. With the above aims, the objectives of this study are:

1. to analyse a range of performance indicators, including risk-adjusted performance, as profitability itself does not provide a broad picture of banking business;
2. to structure the whole Russian banking sector, so that banks' performance would be assessed;

A bank is intermediary that raises savings from those who have a surplus to those who have a deficit of funds in pursuance of productive activities funding. A bank provides people and businesses with a range of financial services and solves "asymmetric information" problems, and thus, it lessens expenses related to obtaining the information about both borrowing and savings opportunities. And these services increase the efficiency of overall economy (Federal Reserve Bank of San Francisco, 2001). Nowadays, the banking industry has a colossal significance to everyone: equally to certain individuals, as to business units. Wu *et al.* (2006) emphasized that there is a great dependence on the services that banks provide and theirs quality. And as a result any banks' failures and problems menace the world economic system with dismal consequences. Thus, the way how banks do the business becomes an important area of examination for stakeholders (Fethi and Pasiouras, 2010).

Banks' Performance and Efficiency

Several recent studies have endeavoured to determine the factors affecting banks' performance and efficacy, as well as to predict them. Recent research on a prediction of Turkish banks defaults by Ozkan-Gunay and Ozkan (2007) with the help of neural networks indicates that the majority of defaults could be foretold beforehand and it could be used to find special signals of possible problems. Contrary to the research of Ravi *et al.* (2008), Gunay and Ozkan (2007) predicted not the efficiency or performance of a bank, but default. Naturally, default prediction would be more accurate, because a number of output variables are determined more clearly. Shih *et al.* (2007) used 112 commercial banks' 10 financial ratios, which represent a technical efficiency of Chinese banks to obtain four performance indicators, and found significant dependence of political and economic factors on the performance of Chinese banks rather than peculiar banks' attributes (e.g. size). Further, Shih *et al.* (2007) used more or less current data but they were for one year time horizon, so an additional investigation is needed to understand the Chinese Banking sector

completely. Ravi *et al.* (2008) presented *"a soft computing"* prediction system of bank efficiency based on the sample of 1000 community banks, which used 2-years' (1991-1993) financial information to forecast the coming year's results. As input variables they used 33 numerical and 6 categorical financial indicators related to capital, assets, liabilities, income, expenses and some other bank attributes. Similarly, Staub *et al.* (2010) examined allocative, cost and technical efficiencies in the Brazilian Banks for the period 2000-2007. They concluded that the efficiency of Brazilian banks was low as compared to other countries. In another study by Olson and Zoubi (2011), a comparison of performance indicators calculated with the help of accounting and economic data of 527 banks in 10 Middle and North Africa (MENA) countries for 2000-2008 was conducted. Analysing MENA banks, it was found that banks in developing countries are efficient alike. It is stated that MENA banks are relatively profit-efficient and most of them are below the optimal size. As opposed to the research of Ravi *et al.* (2008) and Shih *et al.* (2007), a current dataset was used and the time period was more extensive. More importantly an attempt to estimate indicators efficiency was made which supported their results that concentration on profit efficiency is more important than cost.

Fethi and Pasiouras (2010) argued that commonly used bank specific factors that determine efficiency and performance of banks are size, profitability, capitalization and loans to assets. They found two approach analysis such as: one is to divide banks into several groups and calculate indicators' averages in order to find the interdependence; the other way is incorporation of factor variables in a second stage analysis. A number of studies concentrate on investigating the effects of ownership by foreign owners. Bonin *et al.* (2005) employed data for the period 1996-2000 on Banks from 11 transition countries and demonstrated that "*foreign-owned banks are more cost-efficient than other banks and that they also provide better service, in particular if they have a strategic foreign owner*" (Bonin *et al.*, 2005, p. 31). The same result was reported by Sturm and Williams (2009) for Australian banks for the period 1988-2001.

In another study, Kosmidou *et al.* (2006) examined the performance of UK Banks for 1998-2001, concentrating on differences between the performance of domestic and foreign banks that have business in the United Kingdom. Finally, as opposed to the findings of Bonin *et al.* (2005) and Sturm and Williams (2009), it was found "*that foreign banks in the UK operate with lower return on equity, net interest revenue/total earning assets, loans/customer and short-term funding as compared to the domestic banks*" (Kosmidou *et al.*, 2006, p. 192). Havrylchyk (2006) argues that during 1997-2001, the efficiency of foreign and domestic banks worsened, but in comparison to above research studies it was found that greenfield banks have better efficiency characteristics than both domestic and foreign banks which bought domestic ones. Some other researchers have investigated state-owned Bank performance. It was found that Spanish Banks controlled by public administrations are less efficient than Banks controlled by managers and workers (Garcia-Cestona and Surroca, 2008). Moreover, there are some reported results stating that the state-owned banks have better efficiency levels than private ones, e.g. in Turkey (Isik and Hassan, 2003).

Regulatory Impact and Efficiency

There are a certain number of studies that investigate the influence of regulatory reforms on Banks' efficiency and performance. Pasiouras *et al.* (2006) in their cross-country analysis of Banks found out that higher Equity-to-Assets ratio leads to better

ratings if there is no banking supervision and control regulations. Moreover, there is a significant impact on ratings by restrictions on bank activities, high power levels of deposit insurer, capital requirements, diversification and liquidity guidelines, etc. "*Disclosure requirements and foreign banks entry have a significant impact on ratings only when we simultaneously control for the regulatory environment and the market structure, while auditing requirements have a significant impact only when we control for the regulatory environment alone*" (Pasiouras *et al.*, 2006, p.403). A positive correlation has been indicated for example in India and Pakistan (Ataullah *et al.*, 2004).

On the other hand, study into the efficiency of 485 German and Austrian Banks conducted by Hauner (2005) states that there is no effect of deregulation in terms of better performance indicators for the period 1995-1999. Fethi and Pasiouras (2010) citing the views of Brissimis *et al.* (2008, p.194) supported an interesting observation: "*The banking sector reform in the newly acceded EU countries had a positive impact on bank efficiency, while the effect of reform on TFP* [Total factor productivity] *growth was significantly only toward the end of the reform process*". All things considered, it is impossible to determine a strong relationship between the impact of regulation/deregulation and banks' efficiency and performance.

The Efficiency of Bank Branches

Several studies concentrated on the efficiency of Bank branches and not individual Banks. Generically, branches are considered as production units and the number of transactions made demonstrates its output (Fethi and Pasiouras, 2010). In a study by Rao and Tiwari (2008) the Indian banking sector was analyzed for the period 2001-2005 and it was found that the efficiency factor related to a branch is highly correlated to all outputs of the efficiency of a Bank, i.e. assets, deposits, and advances for public sector banks; per branch factor measures the contribution of per branch efficiency in overall efficiency of public sector banks.

Similarly, Wu *et al.* (2006) used Data Envelopment Analysis (DEA) and Artificial Neural Network (ANN) to evaluate the branch performance of 142 Canadian Banks. It was concluded that "*the bank branch efficiency is a comprehensive measure…, the relationship between the bank branch efficiency and multiple variables is highly complicated and nonlinear*" (Wu *et al.*, 2006, p.109). Also, Portela and Thanassoulis (2007) found that service quality as an important dimension of efficiency of bank branches has positive correlation to its operational and profit efficiency. DEA determines a weights series to maximize an objective function. Alternatively, ANN determines a weights series to obtain the optimal fitting by means of training data set observations. It was stated that "*the neural network approach requires no assumptions about the production function (the major drawback of the parametric approach) and it is highly flexible*" (Wu *et al.*, 2006, p.114).

Comparison of Techniques

There are number of studies that compare techniques to assess the performance or predict failures. Alam *et al.* (2000) compared the results derived by the closest hard partitioning of fuzzy clustering and by self-organizing neural networks. As an outcome a specific rating of relative bankruptcy likelihood was prepared. It was shown that both techniques are promissory tools to classify Banks and assess their performance. Kumar and Haynes (2003) explored firms' financial performance data

in relation to the credit rating of a debt issue and found out that ANN is superior to the discriminant analysis model as it allows increasing the speed and efficiency of the rating process. In accordance with the results of Alam *et al.* (2000), Wu *et al.* (2006) and Kumar and Haynes (2003), ANNs are better suited to the analysis of a Banking sector, because they are flexible, but it can be too complex and slow.

Alternatively, Baourakis *et al.* (2007) used a dataset of 1100 UK firms and proposed Multi-criteria methodology to rate the credit risk which provided promising results compared to Linear Discriminant Analysis and Ordered Logistic Regression (OLR). Ioannidis *et al.* (2010) compared models in a data set of 944 Banks from 78 countries that use financial variables only, with those using some extra indicators related to the external factors such as regulatory environment and macroeconomic conditions. Classifying the data set with UTilités Additives DIScriminantes (UTADIS), ANN, Classification and Regression Trees (CART), k-NN, OLR, Multiple Discriminant Analysis and Stacked Generalization Approach, they found that UTADIS and ANN provided highest average accuracy and the accuracy of classification of models that used the full set of variables (financial ones as well as external factors) was higher.

However, in a study by Mostafa (2009) with 100 Arab banks it was found that neural networks would predict banks' performance successfully as well as traditional statistical methods (e.g. multiple discriminant analysis). While the studies mentioned above compare different mathematical methods, Ho and Wu (2006) with a dataset of 3 Australian banks for a year 2000 compared the Grey Relation Analysis (GRA) to financial statement analysis and found that the GRA approach is better as a reduced number of financial indicators is needed (23 instead of 59). To conclude, there is no general answer which tool or technique is better in terms of accuracy and speed relation, but all of the approaches demonstrate acceptable results that can replicated.

Risk-Adjusted Performance

Most of the research studies conducted during the last few years dealt with banks' performance but there is no consideration of the risk taken by institutions in the process of profit earning. Basically, performance and efficiency are calculated by finding the share of return in a certain category (Damodaran, 2007) for instance, Return on Capital (ROC), Return on Equity (ROE) and Return on Assets (ROA) measures. Damodaran (2007) states that it is imperative to obtain a reliable estimate of returns on investments, but the significant factor - risk taken - was missed. Ravi *et al.* (2008), Olson and Zoubi (2011) and others have calculated and classified banks based on a basic definition of performance that is not adjusted for risk.

The Risk Adjusted Return on Capital (RAROC) framework developed by Banker's Trust bank (Chugunov and Lobanov, 2003) and later modified, thus creating the Return on Risk Adjusted Capital (RORAC) and Risk Adjusted Return on Risk Adjusted Capital (RARORAC) frameworks. These frameworks involve a calculation of risk-adjusted performance measures that have been adopted within the financial sector as a measure of economic efficiency with a consideration of risk. Additionally, risk-adjusted performance measures are comparable and therefore they could serve as criteria of capital allocation among departments and portfolios.

Moreover, there is no general approach to assessing expected losses; they can be obtained from separate estimates for every group of risk (market, credit, operational, etc.) or as an aggregate measure. The method of estimation is also not strictly determined: Value at Risk models, expertise or any other analysis can be

used. However, Oliver, Wyman and Company has developed an instrument for internal use of banks and companies; for instance, Russia's biggest bank Sberbank (Konuzin, 2003) and Bank of America (James, 1996) use RAROC. Overall, RAROC measure is widely used as an internal tool, but no study has been found that uses risk-adjusted performance to classify the banking sector and/or predict failures.

Russian Banking Sector

Russia has inherited the Soviet banking system with a few large state-owned banks. In mid-90s to achieve stability and further acceleration in the financial sector, a reform was performed. In 1998 there was a financial crisis in Russia and the banking sector experienced serious disorder: more than 500 banks went bankrupt (Lanine and Vennet, 2006). To foresee such bank failures and to increase the stability and transparency, the Central Bank of Russia has developed a number of guidelines and regulations in accordance with the international norms.

Despite the fact that the Russian Banking sector was the fastest developing part of the Russian economy (Pollisinski, 2006) for the last decade, it is still controversial. The Banking sector is dominated by a couple of very large and state-owned Banks, and according to the research of the information agency StatBanker (2010) state-owned Banks have a share of 51.4% in Banking and Finance sector. In a study, Gnezditskaia (2003) argues that the most remarkable characteristic of the modern Russian banking system is differentiation of regulations and norms applied to different banks. Often the environment (political as well as regulatory) differs with every single bank. Gnezditskaia (2003) concludes that the Banking system in Russia is fragmented and industry-dependent.

Research Gap

In accordance with the above theoretical background, it is clear that many studies have been published on the analysis of Banks as financial institutions classifying them to determine performance of banks as a whole or the efficiency of separate branches, the impact of ownership or reforms and, finally to compare the accuracy of quantitative techniques. Most of these studies use financial statements as secondary data which is widely available within the Banks' annual reports.

Within the Russian Banking sector, Gnezditskaia (2003) provided just a descriptive study on Russian Banks, analysing their profit strategies depending on ownership type, but does not use any mathematical methods of analysis. In a study by Lanine and Vennet (2006), a parametric logit model was used to predict failures from a dataset of year 2004 and there was nothing that could help to understand the determinants of Banks' success. Therefore, there is no research that deals with the entire population of Russian Banks incorporating the Russian Crisis (1998) as well as the Global financial crisis (2008). Furthermore, to the best of our knowledge no previous studies have been found which investigated the changes of the Banking sector's structure over time. Thus, this could be the key missing element in determining the performance of Banks within the Russian Economy.

DATA

In accordance with the federal law of the Russian Federation "On banks and banking activities", article number 8, a credit institution is obliged to publish a balance sheet and income statement with the opinion of the auditing firm (auditor) on the reliability

on yearly basis in set form by Bank of Russia (Russian Federation, 2008). The central bank in Russia – Bank of Russia publishes banks' annual reports online (Bank of Russia, no date) and they can used for further analysis. A census can be used in the process of data collection, if it is possible to collect data from all units available in the system. Naturally, analysis of data collected through full census is more accurate than analysis of data samples. For this reason it was decided to collect data on all the banks that operate in Russian Federation. Finally, the time horizon was chosen as the period 2000-2010. The lower boundary is chosen because the Russian economy began recovering in this year (2000) after the crisis of 1998. During 2000-2007 the average annual increase of GDP was 7% (US$ 6,758 in 2000 to US$ 14,692 in 2007); foreign-currency and gold reserves increased from 12.45 billion US dollars to 477.9 billion US dollars; the real income of the population grew by an average of 11% per year (Rogov, 2008). In 2008 Russian economy suffered a lot: because of serious imbalance in the economy as well as the global financial crisis (Ivanova, 2010).

Overall, the period 2000-2010 covers different stages of the Russian economy and will represent comprehensive structure and performance indicators of Russian banks. Unfortunately, the Bank of Russia publishes data not on an appropriate database, but in HTML format. Moreover, the number of banks is large – 1,279 institutions in 2000, 995 in 2010, and there is no possible way to collect all the balance sheets and income statements manually. Because of this, it was decided to program PHP software that would help to download and organize the dataset. Further, a SQL queries could be run over with any statistical or programming tool to analyse the information gathered.

A system of transaction records and their presentation is a necessary part of every business, including banking business; financial statements represent such a system (Tennent, 2008). However, it is very difficult to understand whether a business is performing well and to compare it to other businesses with only statements' terms; that is why financial ratios exist. They show existing connections between different business parts and are metrics of business performance (Walsh, 2008). Using the research results of Ravi *et al.* (2008), Ioannidis *et al.* (2010), Olson and Zoubi (2011) and a work of Walsh (2008), a range of financial ratios were selected for future analysis.

As for performance and profitability, ROA and ROE were chosen as fundamental performance ratios (Walsh, 2008):

$$ROA = \frac{After - tax\ operating\ income}{Book\ value\ of\ total\ assets}$$

$$ROE = \frac{After - tax\ operating\ income}{Book\ value\ of\ total\ equity}$$

Liquidity is an important figure as it helps to evaluate whether there is sufficient assets to meet liabilities. A common test of a company's liquidity is the current ratio (Tennent, 2008):

$$Current\ ratio = \frac{Current\ assets}{Current\ liabilities}$$

However, this formula has to be adjusted to be used to assess banks' liquidity. The Bank of Russia (2004) published directions "On the mandatory banks' ratios"; it sets rules on the methods of calculation of current assets and current liabilities. For

instance, it determines items that are included in current assets. As for current liabilities:

$$Current\ liabilities = Ovt - 0.5 \cdot Ovt^*$$

Ovt – Current liabilities, similar to current liabilities in a general case;

Ovt^* - Deposits of individuals and legal entities (except credit institutions).

The financial strength of a bank or its ability to withstand operating setbacks would be represented by debt-to-equity ratio, which is one of the most fundamental measures in corporate finance (Welsh, 2008):

$$D/E = \frac{Total\ debt}{Total\ funds}$$

Additionally, to analyse the structure of the Russian banking sector, some absolute measures are needed to compare banks in terms of size:

- Assets (total)
- Equity (total)
- Deposits (individuals and legal entities)
- Net income (loss)

All ratios and indicators mentioned above can be calculated directly from balance sheet and income statement terms. The descriptive statistics for the ratios and indicators for the period 2000-2010 for the 883 banks are presented in Appendix A. Also more importantly, the RAROC measure is to be included in analysis to represent risk-adjusted return. RAROC is calculated in the following way (Chugunov and Lobanov, 2003):

$$RAROC = \frac{Earnings - Expected\ loss}{Economic\ capital}$$

Earnings are stated in the income statement. However, because there is no general approach to assess expected losses, the following method would be chosen based on the dataset. The Bank of Russia publishes balance sheets and income statements that do not allow the separation of estimates for every group of risk (market, credit, operational, etc.); because of this, an aggregated measure was chosen. Value-at-Risk framework was chosen to asses expected losses. There are a wide range of approaches; generally variance-covariance, historical simulation and Monte-Carlo simulation which could be employed. Unfortunately, none of them is ideal (Sollis, 2009). The variance-covariance approach is usually criticized for normality assumption, but Tan and Chan (2003) concluded that it can still be appropriate. As for historical simulation, this does not have the assumption of normal distribution, but is very sensitive to changes in the size of the sample employed. As a result, it underestimates or overestimates risks (Sollis, 2009). Monte-Carlo simulation, again assumes the normal distribution with corresponding consequences. Because variance-covariance approach is fast and flexible, it will be used to assess expected losses.

$$Expected\ loss = \sigma_{earnings} \cdot \Phi^{-1}(\alpha)$$

$\sigma_{earnings}$ – Standard deviation of yearly earnings;

$\Phi^{-1}(\alpha)$ – Inverse of the standard normal distribution, confidence level is equal to α.

Because there is a need to calculate a standard deviation, RAROC cannot be calculated for the years 2000 and 2001, so the analysis will be conducted for the period 2002-2010. As for economic capital, this is calculated internally and represents the amount of capital a bank should have to cover any risks (Chugunov and Lobanov, 2003). Because it is impossible to obtain the internal information of all the banks for 2000-2010, an assumption of equality of economic capital and equity capital can be accepted. Finally, the RAROC measure is a comparable measure of both risk and return.

METHODOLOGY

Based on the theoretical framework presented above, it is possible to come to the conclusion that, as a rule, application of mathematical methods to estimate and predict banks' performance and efficiency is successful. Before proceeding to in-depth analysis of the structure of the Russian Banking sector, it is necessary to identify the patterns and consistency in the data. It is possible to find some patterns by building diagrams of indicators in dynamic. Using the plots of the average, standard deviation and increase rate, the trend analysis of indicators will be performed. The analysis of Banks' structure in 10-dimensional space could entail great difficulties, because these variables can correlate to each other. For this reason, a Principal Component Analysis (PCA) would be used to reduce the number of dimensions.

An objective of PCA is to displace N correlated variables by M uncorrelated ones, and $M < N$ (Bartholomew *et al.*, 2008). It is recommended to perform PCA because it helps to check data assumptions and reveal abnormalities in a dataset (Johnson, 1998). The next step is analysis of factor variables; to determine the structure of the Russian Banking sector, a classification will be performed with the help of cluster analysis. To determine the number of clusters, hierarchical clustering will be performed by grouping objects into clusters in a nested sequence of clusterings and using tree diagrams. Hierarchical clustering will provide a number of clusters for further analysis. Finally, based on the number of clusters, k-Nearest Neighbours (k-NN) clustering will be implemented, which is a non-hierarchical algorithm. Initial cluster centres will be selected by sorting distances and taking observations at constant intervals. It is necessary to note that as the period 2000-2010 is analysed, case wise deletion will be performed to obtain a range of banks that existed throughout this period of time. As a result, 883 banks will be analysed.
An assessment of the consistency level between variables should be implemented; one type of reliability is test-retest (Hair *et al*., 2010), by analysing the data for 2000-2010, results could be retested at different points in time. A second measure of reliability is internal consistency, which can be measured by Cronbach's alpha (Statsoft, 2011) which says that the study is reliable for $\alpha \geq 0.7$:

$$\alpha = \frac{k}{k-1} \cdot \left(1 - \frac{\sum_{i=1}^{k} \sigma_{y_i}^2}{\sigma_x^2}\right)$$

k – Number of variables,

$\sigma_{y_i}^2$ – Variance of variables

σ_x^2 – Total variance.

Sample size can be considered a source of bias, but the entire population of banks is used, so there is no bias related to the sample. To validate multivariate analysis, a variance analysis will be performed.

RESULTS

Total Assets, Equity, Deposits, Net Loans and Net Income: These five indicators are presented directly on balance sheets and income statements, so no calculations are needed. Values of the indicators for 2010 of top 5 largest banks are shown in Table 1. All values presented in trillions of Russian roubles.

TABLE 1. TOTAL ASSETS, EQUITY, DEPOSITS, NET LOANS AND NET INCOME FOR 2010 (RUSSIAN ROUBLES IN TRILLIONS)

Bank	Total assets	Total equity	Deposits (individuals and legal entities)	Net loans to customers	Net income
Sberbank	8.52	1.05	6.67	5.71	0.17
VTB	2.78	0.62	1.23	1.88	0.04
Gazprombank	1.84	0.14	1.39	1.32	0.01
Russian Agricultural Bank	1.031	0.12	0.56	0.86	0.001
Bank of Moscow	0.84	0.05	0.59	0.59	-0.05

Current Ratio, D/E ratio, ROA and ROE: Using formulae described in the "Data" section, SQL queries were prepared to implement this automatically. Values of the indicators for 2010 of the top 5 banks are presented below.

TABLE 2. CURRENT RATIO, D/E RATIO, ROA AND ROE FOR 2010

Bank	Current ratio	D/E ratio	ROA	ROE
Sberbank	2.0108	7.1183	2.0412%	16.5712%
VTB	1.7010	3.5054	1.5565%	7.0126%
Gazprombank	1.9904	12.2396	0.6702%	8.8729%
Russian Agricultural Bank	1.8752	7.9004	0.0983%	0.8749%
Bank of Moscow	1.7432	14.4551	0.0180%	-92.0564%

RAROC: James (1996) reports that at the Bank of America 99.97% confidence level is used, so this coverage level will be used to assess expected losses:

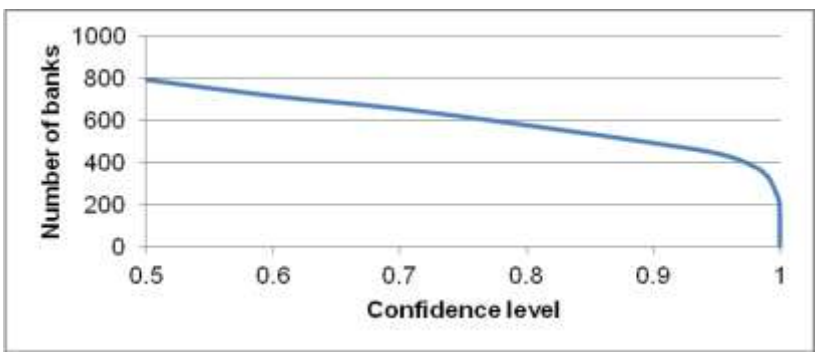
$$Expected\ loss = \sigma_{earnings} \cdot \Phi^{-1}(99.97\%)$$

Thus, the number of profitable banks with confidence level of 99.97% for 2010 is 185:

TABLE 3. NUMBER OF PROFITABLE BANKS IN TERMS OF RAROC (2010)

Confidence level	Number of profitable banks
0.5	792
0.6	715
0.7	654
0.8	576
0.9	491
0.95	442
0.975	392
0.99	333
0.999	222
0.9997	185
0.9999	152
0.99999	118
0.999999	86

FIGURE 1. NUMBER OF PROFITABLE BANKS IN TERMS OF RAROC (2010)



Therefore, 99.97% confidence level provides admissible and realistic results. SQL query was conducted to perform these calculations. RAROC values for 2010 of the top 5 banks are presented below.

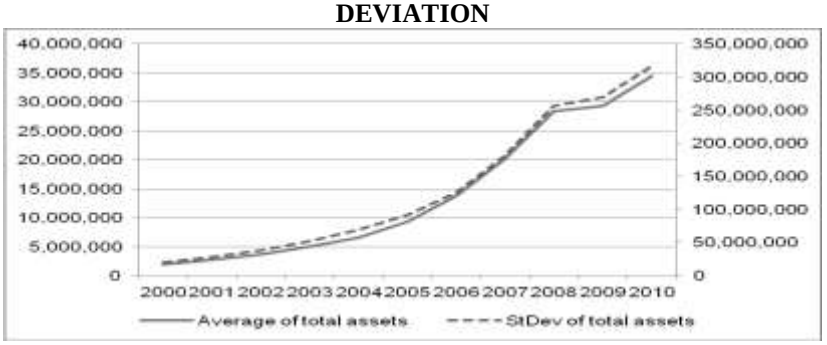
TABLE 4. ROAROC FOR 2010

Bank	RAROC
Sberbank	4.4310%
VTB	2.8789%
Gazprombank	-6.4313%
Russian Agricultural Bank	-1.4731%
Bank of Moscow	-107.4299%

Trend Analysis: Total Assets, Deposits and Net Loans

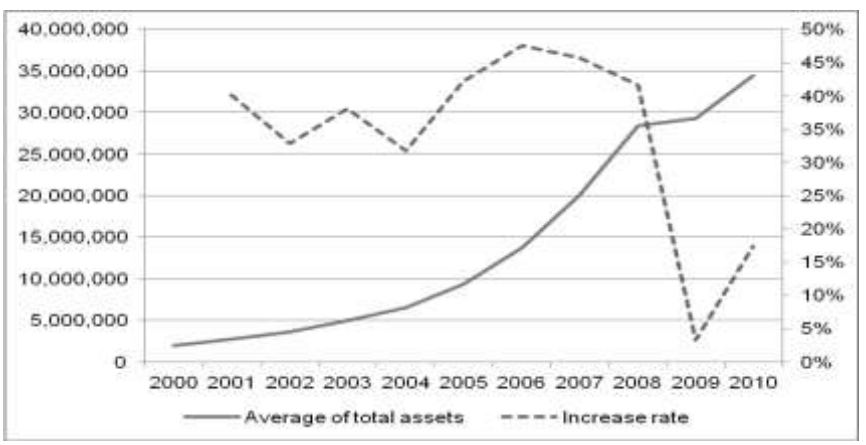
To begin with, the amount of total assets of banks will be explored by building a figure of the total assets average and its standard deviation (hereinafter all absolute values are measured in thousands of Russian roubles, and years on graphs refer to the values as on 1st of January of the following year):

FIGURE 2. TOTAL ASSETS: AVERAGE AND STANDARD DEVIATION



As shown in the Figure 2, on the whole, the amount of total assets rose for the period 2000-2010; but the rate of increase has changed; this is clearly seen in the period 2008-2009. However, the standard deviation also rose for the whole period of time; thus it demonstrates a tendency of increasing average as well as spread and inequality. A graph of the increase rate can help to find patterns more accurately:

FIGURE 3. TOTAL ASSETS: AVERAGE AND INCREASE RATE



In accordance with Figure 3, the rate of increase declined dramatically in 2008, when it was 41.64%, whereas in 2009 it was 3.34% (a drop of 38.3%); moreover, the increase rate was not stable during 2000-2004, but still high. As for 2010, the growth of total assets intensified. Practically the same picture can be found when analysing the average amount of net loans; to demonstrate this, similar graphs were drawn – Figure 4 and Figure 5:

FIGURE 4. NET LOANS: AVERAGE AND STANDARD DEVIATION

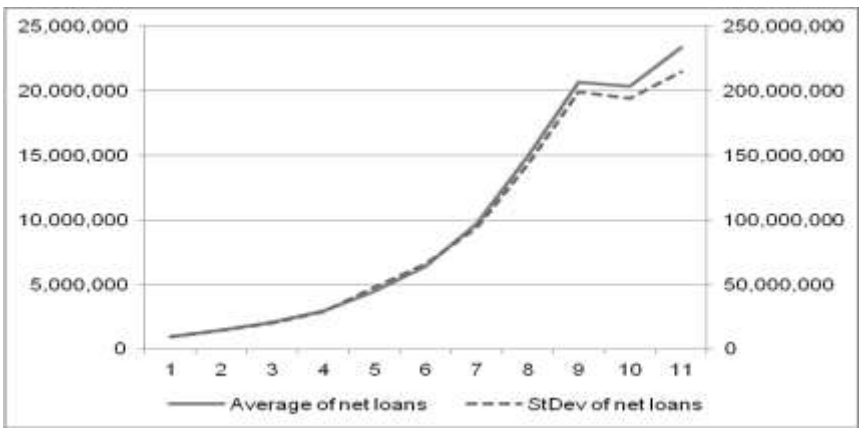
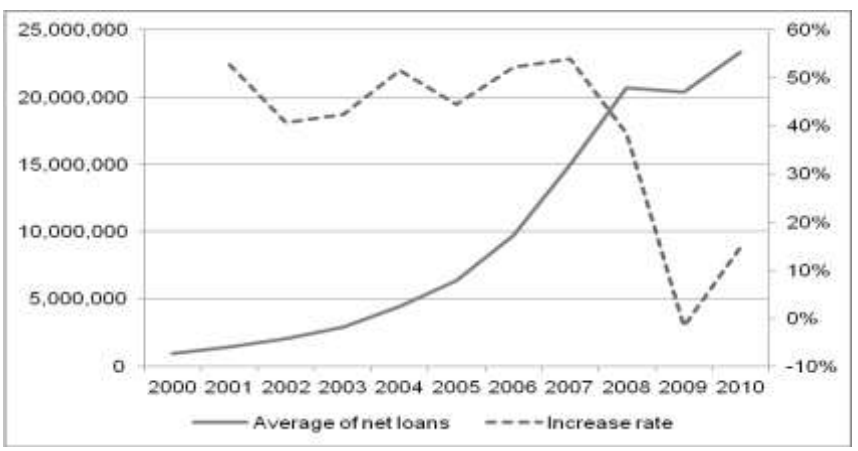
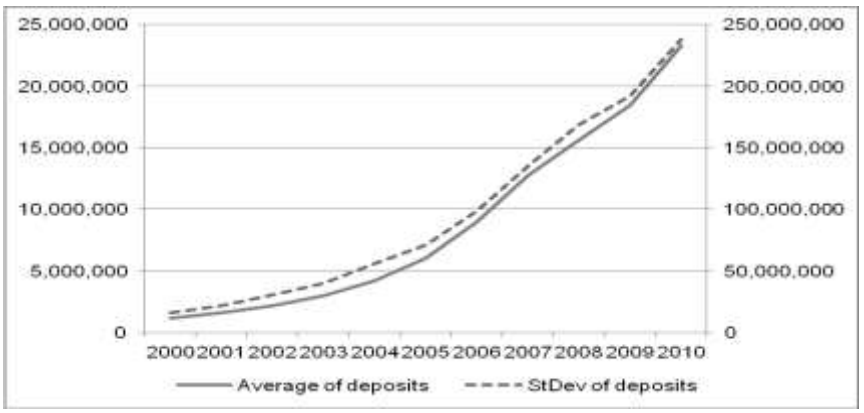


FIGURE 5. NET LOANS: AVERAGE AND INCREASE RATE



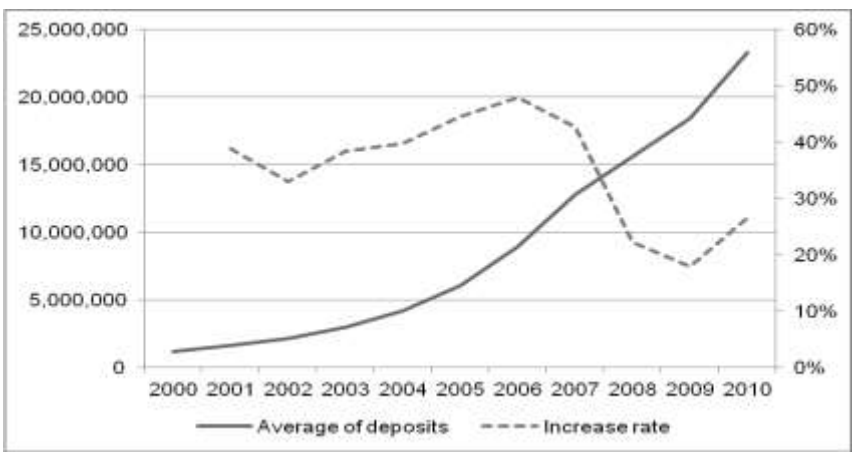
The average, standard deviation and growth rate patterns of the amount of net loans are very similar to those of deposits: high growth rate during 2000-2007, a drop of 39.99% in 2009 and its intensification in 2010. What is more, there was a similar slowdown of growth rate in 2008. Next, the amount of deposits will be analysed with the same technique – average and standard deviation graph:

FIGURE 6. DEPOSITS: AVERAGE AND STANDARD DEVIATION



Similarly, a constant growth in the average amount of deposits can be recognized as well as its standard deviation, but again it is difficult to understand its growth rate, so a graph with average and increase rate of deposits was drawn (as presented in Figure 7).

FIGURE 7. DEPOSITS: AVERAGE AND INCREASE RATE

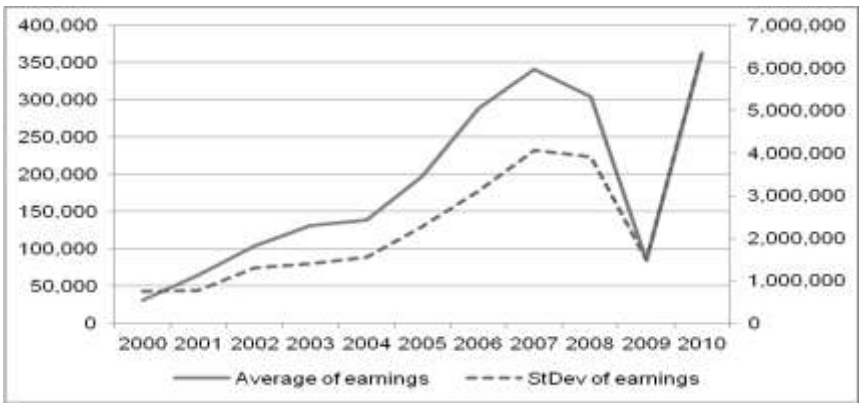


The graph of the increase in the average deposits rate has a similar pattern, but it is smoother than those of assets and net loans – a drop in 2009 accounts for 4.24%, whereas the major fall in the growth rate occurred in 2008 – 22.57%. All the above figures demonstrate that the crisis has significantly affected the banking sector. Additionally, as standard deviation of total assets, net loans and deposits have also grown, the structure of the Russian banking sector is not constant and was changing during the period 2000-2010.

Earnings and D/E ratio

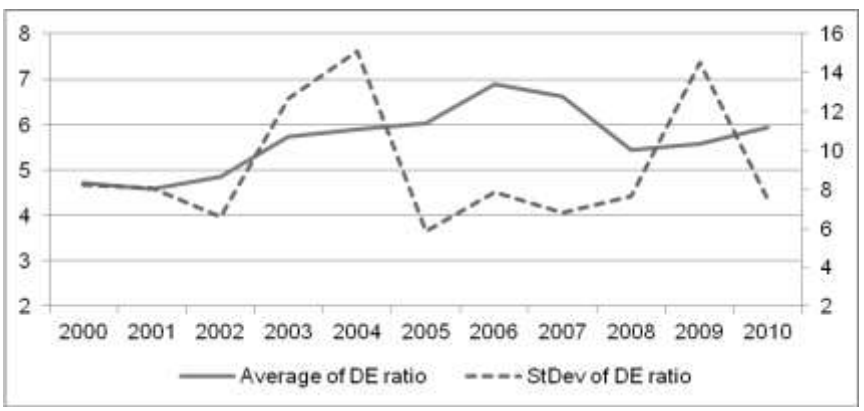
Total assets, net loans and deposits are not directly linked to banks' performance; earnings item is an absolute measure that reflects the profitability.

FIGURE 8. EARNINGS: AVERAGE AND STANDARD DEVIATION



According to Figure 8, the growth of average earnings in 2000-2004 was also unstable and there was huge growth in 2004-2007. At the same time, a growing standard deviation represents an increasing differentiation in the Russian banking sector. In the same way, a decline in earnings during 2007-2009 can be explained by the financial crisis. The simultaneous slump of both standard deviation and average of earnings demonstrates that almost all banks have suffered from the crisis. As mentioned above, D/E ratio represents financial strength. Figure 9 illustrates the analysis of the Russian Banking sector in 2000-2010 in terms of financial strength.

FIGURE 9. D/E RATIO: AVERAGE AND STANDARD DEVIATION



Similarly, average banks' financial strength was improving during the period 2000-2007 although this process was not stable in the first years. Changes in values of standard deviation present the changing structure. A decreasing value of the average of D/E ratio in 2007-2009 shows that a financial crisis occurred.

ROA, ROE, RAROC and general pattern

ROA and ROE are relative measures of profitability and more valuable than absolute measures (e.g. earnings). Figure 10 and Figure 11 illustrate the analysis of ROA and ROE ratios (hereinafter, "Poly." lines on plots stand for polynomial trend lines).

FIGURE 10. ROA: AVERAGE AND STANDARD DEVIATION

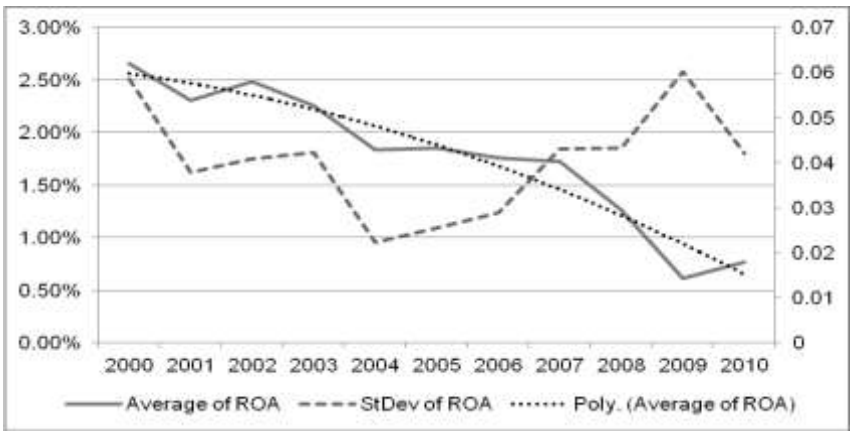
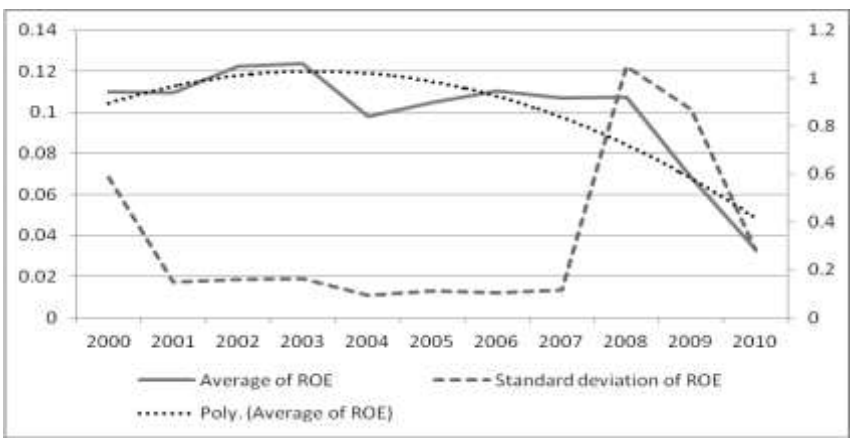


FIGURE 11. ROE: AVERAGE AND STANDARD DEVIATION

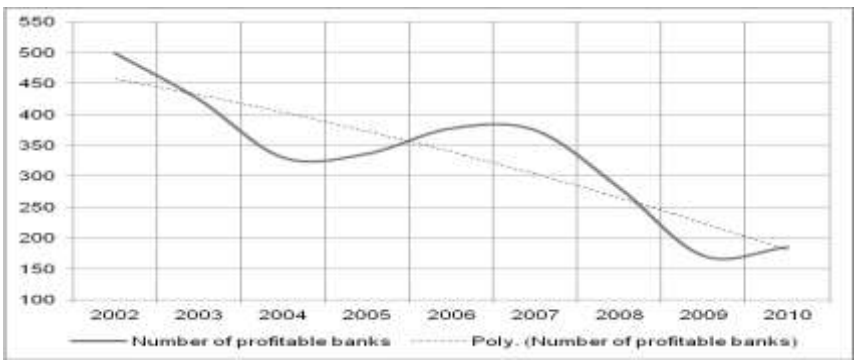


Average ROA and average ROE patterns are quite similar but, surprisingly, they are different from those of all the above measures. This reveals the fact that despite the increasing amount of assets, net loans and deposits, banks' profitability decreased. This can be explained by the process of market regulation; many laws and instructions have been prepared by the Russian government since the end of 90s – the market began regulating itself, banks missed the opportunity to earn enormous profits by questionable methods. ROA and ROE stand for profitability, but it is important to bring the performance into correlation with the risk taken. RAROC is a measure that represents risk-adjusted performance. In terms of RAROC, there were 499 profitable banks in 2002 and the number declined to 185 in 2010 (as presented in Table 6, Figure 12).

TABLE 5. NUMBER OF PROFITABLE BANKS IN TERMS OF RAROC, 2002-2010

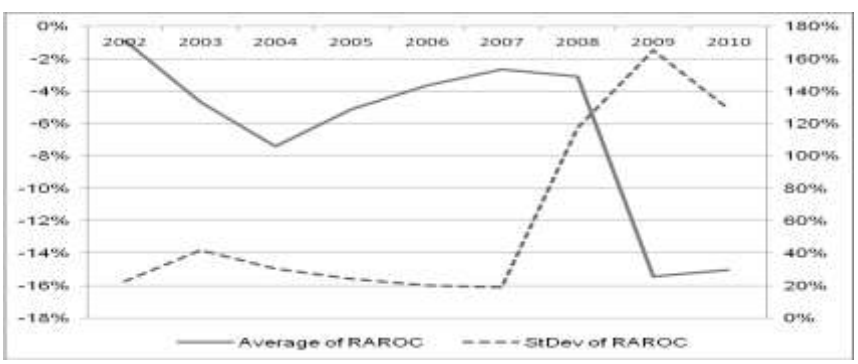
Year	Number of profitable banks
2002	499
2003	424
2004	330
2005	336
2006	377
2007	374
2008	281
2009	171
2010	185

FIGURE 12. NUMBER OF PROFITABLE BANKS IN TERMS OF RAROC, 2002-2010



During the financial crisis, the number of profitable banks decreased by 54.28%, which corresponds to the pattern shown above. More importantly, there is a need to analyse the average RAROC itself; Figure 13 illustrates the average of RAROC and its standard deviation in 2002-2010.

FIGURE 13. RAROC: AVERAGE AND STANDARD DEVIATION

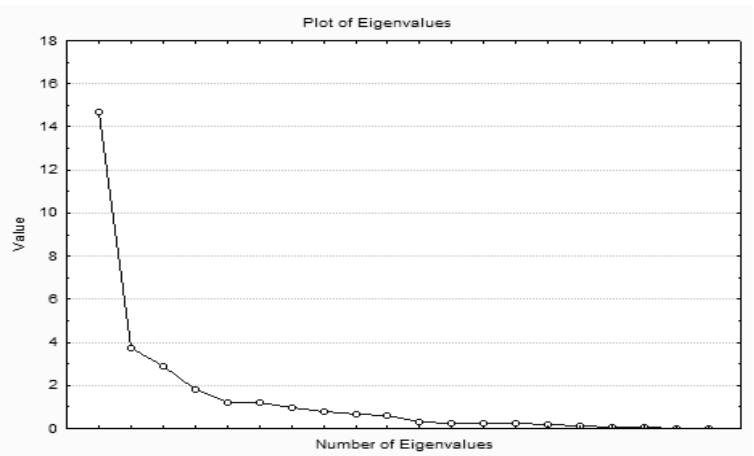


Despite the fact that ROA and ROE patterns differ from total assets, net loans, deposits and D/E ratio, the pattern of the average of RAROC is similar to the pattern of the majority of indicators. It is also volatile in the first few years, after which the average of RAROC of Russian banks grew (2004-2007). The slump in the average of RAROC during the financial crisis is clearly reproduced – 0.43% decrease in 2008 and 12.32% decrease in 2009; in 2010 there was an increase of 0.4%. As for standard deviation of RAROC, it was quite stable during the period 2002-2007, but it soared at the time of crisis. This indicates that the crisis resulted in changes of the structure of the Russian banking sector. Finally, the period 2000-2004 can be called the period of stabilization after the crisis of 1998 and adopting new legislation; the period 2004-2007 is the period of substantial development; the period 2007-2009 is the period of financial crisis and banking sector decay; after 2009, the banking sector began moderate development.

2002-2004 – Period of Stabilization

There is a 30-dimensional space of indicators for the period of stabilization: three years and ten indicators per year. Firstly, factor analysis is implemented using the PCA extraction method. Figure 14 illustrates scree plot of eigenvalues:

FIGURE 14. SCREE PLOT, 2002-04



Minimum eigenvalue is set to 1, and then the following six eigenvalues remain:

TABLE 6. EIGENVALUES, 2002-04

Eigenvalues Extraction: Principal components

	Eigenvalue	% Total - variance	Cumulative - Eigenvalue	Cumulative - %
1	14.67226	48.90752	14.67226	48.90752
2	3.71463	12.38210	18.38688	61.28962
3	2.91338	9.71128	21.30027	71.00089
4	1.81840	6.06135	23.11867	77.06224
5	1.20255	4.00849	24.32122	81.07073
6	1.18495	3.94983	25.50617	85.02056

Only 15% of variance remained unexplained, whereas the number of input variables decreased by 80%. Furthermore, varimax factor rotation will be used to gather factor loadings that can be interpreted easily. Factor 1 explains 48.84% of total variance and it is basically influenced by following variables:

- Assets (total) (2002, 2003, 2004)
- Deposits (individuals and legal entities) (2002, 2003, 2004)
- Equity (total) (2002, 2003, 2004)
- Net income (2002, 2003, 2004)
- Net loans (2002, 2003, 2004)

Naturally, it means that the above five indicators are highly correlated between themselves. Factor 2 explains 7.81% of total variance; its major components are:

- ROA (2004)
- ROE (2004)

As can be expected, ROA and ROE are highly correlated, which is why they were merged into the factor. Factor 3 stands for 10.37% of total variance and is explained by four variables:

- Current ratio (2002)
- D/E ratio (2002, 2003, 2004)

Liquidity and financial strength indicators clearly compose the factor. Factor 4 explains 6.44% of total variance; its major components are:

- RAROC (2003, 2004)

Factor 5 explains 7.49% of total variance and it is basically influenced by following variables:

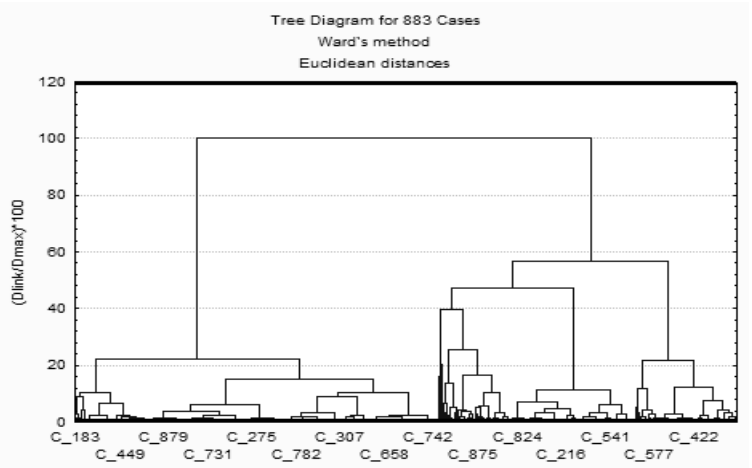
- ROA (2002)
- ROE (2002)

It is difficult to single out major components of Factor 6, because all factor loadings are less than 0.7, but the most influential variables are:

- RAROC (2002)
- Current ratio (2004) (inverse dependence – negative factor loading)

Secondly, hierarchical clustering has to be performed – tree clustering. Ward's method is used as an amalgamation rule; Euclidian distances were selected as distance measures. Figure 15 presents a scaled vertical tree diagram of the amalgamation process.

FIGURE 15. SCALED TREE DIAGRAM, 2002-04



9 clusters were selected by considering the minimum joining distance to be 20%. Then, based on the number of clusters, k-NN clustering is implemented.

TABLE 8. k-NN CLUSTERING RESULTS (2002-04)

Number of variables: 6 Number of cases: 883
K-means clustering of cases, Missing data were casewise deleted
Number of clusters: 9 Solution was obtained after 5 iterations
Euclidean Distances between Clusters
Distances below diagonal Squared distances above diagonal

	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9
No. 1	0.00	2.70	1.48	3.17	3.95	105.62	97.02	135.08	117.38
No. 2	1.64	0.00	0.26	1.02	1.37	108.23	93.95	132.95	117.43
No. 3	1.22	0.51	0.00	1.42	1.09	108.76	93.35	132.60	117.17
No. 4	1.78	1.01	1.19	0.00	3.53	107.18	86.51	133.97	109.91
No. 5	1.99	1.17	1.05	1.88	0.00	110.30	88.70	134.44	113.55
No. 6	10.28	10.40	10.43	10.35	10.50	0.00	167.27	240.43	234.74
No. 7	9.85	9.69	9.66	9.30	9.42	12.93	0.00	225.91	235.59
No. 8	11.62	11.53	11.52	11.57	11.59	15.51	15.03	0.00	248.29
No. 9	10.83	10.84	10.82	10.48	10.66	15.32	15.35	15.76	0.00

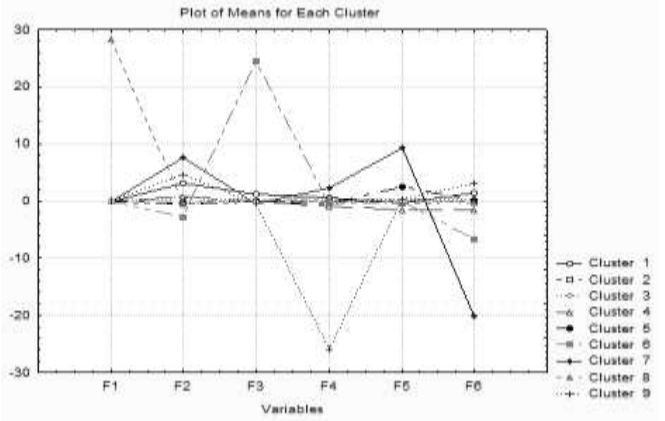
In order to test the validity of the clustering method we use analysis of variance between clusters as presented in Table 9.

TABLE 9. ANALYSIS OF VARIANCE (2002-04)

	Between - SS	df	Within - SS	df	F	signif. - p
F1	796.5535	8	85.4465	874	1018.455	0.00
F2	483.4319	8	398.5680	874	132.512	0.00
F3	640.9041	8	241.0959	874	290.419	0.00
F4	734.7045	8	147.2955	874	544.935	0.00
F5	513.8421	8	368.1579	874	152.481	0.00
F6	648.9868	8	233.0132	874	304.282	0.00

The results of analysis of variance imply that clustering was successful. Finally, each cluster has to be analysed. One of the tools is a plot of the means for each cluster.

FIGURE 16. PLOT OF MEANS FOR EACH CLUSTER, 2002-04



According to Figure 16, it is possible to describe each cluster's characteristics in terms of factors' means. However, to make more precise judgements, descriptive statistics for each cluster are needed: means, standard deviation and/or variance. The structure of the Russian banking sector in 2002-2004 is clear and presented in Table 10.

TABLE 10. THE STRUCTURE OF THE RUSSIAN BANKING SECTOR (2002-2004)

Clusters	Description
2	the majority of banks that could not achieve good results and remained slightly below the average
3	252 banks that slightly outperform the industry
1	successful banks
4	relatively unsuccessful banks
5	banks that were successful at the beginning, but subsequently lost their advantages
6, 7, 8, 9	"Extreme" banks, such as the largest bank - Sberbank

2004-2007 – Period of Substantial Development

The same analysis as in the previous section is performed for the period 2004-2007 and presented in Table 11.

TABLE 11. THE STRUCTURE OF THE RUSSIAN BANKING SECTOR (2004-2007)

Clusters	Description
4	336 banks had financial strength slightly below the average and low performance during the whole period
8	183 banks had financial strength slightly above the average but still low performance during the whole period
1	101 banks demonstrated quite high not risk-adjusted returns; unfortunately they had low levels of financial strength and risk-adjusted performance during the whole period
5	21 banks performed badly in 2004-2006, but achieved very good results in 2007
9	20 banks had returns above the average, but their financial strength can be considered as below the average
12	5 banks with strong financial strength, but which amounts of funds below the average that performed poorly in 2004-2006 but achieved good results in 2007
3, 11	213 banks that performed well during the whole period
2, 6, 7, 10	"Extreme" banks, such as the largest bank – Sberbank

Obviously, the structure in 2004-2007 is more differentiated that in 2002-2004, because banks' management could not implement opportunities provided by the economic development in a similar way.

2007-2009 – Financial Crisis

The same analysis as in the previous section is performed for the period 2007-2009. and is presented in Table 12.

TABLE 12. THE STRUCTURE OF THE RUSSIAN BANKING SECTOR (2007-2009)

Clusters	Description
4	The majority of banks entered into the crisis with low performance indicators and did not performed well during the period 2007-2009 (RAROC is about 0%, ROA is about 15%)
2	198 banks performed well before the crisis and had good financial strength indicators in 2007, but still performed at average levels – not well
1	133 banks performed well before the crisis and could recover faster than the majority – they performed better in 2009 than the majority
9, 11	24 banks had low financial strength at the beginning of the crisis, but achieved good performance results in 2008 and had stable liquidity levels
3, 5, 6, 7, 8, 10, 12	"Extreme" banks, such as the largest bank – Sberbank; these clusters consist of a few banks – up to three; some of them performed very well during 2007-2009, some of them performed extremely badly.

As can be expected, the structure of the Russian banking sector has changed significantly during the crisis; for instance, the majority of banks performed in the same way – poorly. In addition, more banks separated into individual clusters.

2009-2010 – Period of Moderate Development

The same analysis as in the previous section is performed for the period 2009-2010. The structure of the Russian banking sector in 2009-2010 is presented in Table 13.

TABLE 13. THE STRUCTURE OF THE RUSSIAN BANKING SECTOR (2009-2010)

Clusters	Description
4	The majority of banks performed at the average level - RAROC is about 0%, ROA is about 15%; What is more, the number of banks in this cluster is quite similar to those in Cluster 4 in the previous period
3	208 banks started increasing their profits in 2009
6	68 banks started decreasing their profits in 2009
8	17 banks performed very badly in 2009
2	40 banks performed very well in 2009
1, 5, 7, 9, 10	"Extreme" banks, such as the largest bank – Sberbank (clusters 1, 5, 7, 9, and 10), some of them start recovery process very well or have very good liquidity indicators

The structure in 2009-2010 did not change very much from those in previous periods; most banks still could not achieve pre-crisis values. Additionally, these bank groups ("rating groups") can be compared to international ratings. Unfortunately, there is no such rating that covers all banks; international rating agencies rated around 10% of the banking sector, but comparing "Standard & Poor's" , "Moody's" and "Fitch" ratings of some banks, it was found that, for example, the group of successful banks in 2009-2010 have the rating ruAAA/ruAA+/ruAA/ruAA- - S&P or AAA(rus)/AA+(rus)/AA(rus)/AA-(rus) - Fitch (Banki, 2012). The multivariate model can be used in different time periods in order to compare banks' "rating groups". Changes in the banks' position within "rating groups" would illustrate changes in their performance. For instance, a move from "the best" group to "the worst" one would possibly mean that a bank will have serious difficulties and if it continues downgrading it could default; i.e. the software could be used as the default indicator.

CONCLUSIONS

The performed trend analysis allows drawing clear boundary lines between the period of stabilization (2002-2004), substantial development (2004-2007), financial crisis (2007-2009) and moderate development (2009-2010). This period division can be supported by Rogov (2008) and Ivanova (2010), who suggest similar periods for the development of the Russian economy as a whole. Analysing these four periods through multivariate analysis, it is found that the Russian banking sector can be described by mathematical models in the period 2000-2010. Naturally, the structural changes are affected by the described economic cycles, but these changes do not affect the determination capabilities of the model. In the period 2002-2004, nine types of banks are found. There are some prosperous as well as weak banks. During the period 2004-2007, banks had a chance to increase their profits; the banking sector became more differentiated – 12 clusters are singled out. There is no doubt that the financial crisis also affected the banking industry; there were still 12 clusters in 2007-2009, but the majority were concentrated into a single cluster with low performance indicators. Finally, the Russian banking sector started its development in the period 2009-2010, uniting some bank clusters, ten 10 groups are found. The results indicated that through mathematical modelling, Russian banks could be rated as "rating groups" based on their performance which might be of particular interest to bank's managers, investors, credit analysts and bank regulators.

Thus, this study provides a base to analyse the structure of the Russian banking sector and provide interpretable determinants for Russian banks' performance. PHP

software can be used in the future to gather data on the Russian banking sector for any period; similarly, SQL queries can be used to calculate ten financial indicators, including RAROC. The programming script allows the application of similar multivariate analysis to another dataset. Finally, this script can be used to assess the performance of a single bank based on the current research results.

As mentioned above, this study uses the dataset based on yearly financial statements, but using the quarterly data would provide more accurate results that could be different. Analysing the banking sector structure, the data for several years were used; results are provided based not on a static but dynamic situation for a single year. However, there is a question as to how well the links between periods are established; the model can be improved by the introduction of dynamic indicators which represent changes in RAROC, ROA, etc. Also an application of ANN and simulation modelling could be a way to further research in this area. Also, supervised learning and reinforcement learning techniques can be used in future to obtain better results. The developed software can be integrated into online and offline integral information systems to provide an access to future research studies.

APPENDIX A: DESCRIPTIVE STATISTICS FOR THE INDICATORS:

	Total Assets						
	MIN	MEDIAN	MEAN	MAX	STDEV		N
2000	144	158153	1936234.51	553862118	19762988.43		883
2001	829	237430	2712711.89	774785427	27500981.56		883
2002	1189	346391	3603927.90	1083311898	38059911.34		883
2003	934	518318	4974333.44	1464969222	51479147.60		883
2004	1174	641152	6555265.38	1944287656	68696516.62		883
2005	3814	903595	9323431.27	2537179786	90924236.62		883
2006	1795	1207279	13757111.66	3477595770	125675958.02		883
2007	1318	1565082	20042568.70	4937814349	180828585.17		883
2008	1764	1704182	28387554.08	6719019447	256734343.88		883
2009	2044	1860073	29336549.79	7096995293	269065123.67		883
2010	1578	2347007	34437286.20	8523247230	316627113.77		883
	Total Equity						
	MIN	MEDIAN	MEAN	MAX	STDEV		N
2000	-21359716	39116	283448.50	46271534	2478207.65		883
2001	-18305747	51731	431277.59	95032112	3834825.01		883
2002	-17958974	71198	526985.83	115501134	4576002.88		883
2003	410	102289	672727.86	142101970	5399561.71		883
2004	372	130848	811104.13	173524531	6464475.37		883
2005	1142	164374	1137387.66	255043080	9635610.42		883
2006	1132	200875	1559562.53	323229791	12373154.55		883
2007	1244	248560	2649214.67	666094471	25957226.72		883

2008	-201783	305781	3180071.47	775517025	29615589.23		883
2009	-1592782	349566	3856560.85	848253110	35456154.44		883
2010	-950949	391170	4442541.29	1049887154	41961388.76		883
	Deposits (Individuals and Legal Entities)						
	MIN	MEDIAN	MEAN	MAX	STDEV		N
2000	0	73920	1172270.11	462730371	15932111.77		883
2001	0	117685	1627995.62	626155184	21528097.76		883
2002	0	170925	2164783.77	891113979	30386943.56		883
2003	0	268833	2994781.64	1178105309	40240051.44		883
2004	0	353608	4187120.82	1637199130	55964338.16		883
2005	0	523599	6055212.80	2042777862	70689527.07		883
2006	0	742535	8964509.53	2840347516	98611144.25		883
2007	0	1047322	12796839.27	3872732738	135176356.04		883
2008	0	1088995	15634966.04	4802831486	168579851.66		883
2009	0	1245533	18440658.78	5396947880	191981453.60		883
2010	0	1559705	23323636.65	6666977736	237881362.64		883
	Net Loans to Customers						
	MIN	MEDIAN	MEAN	MAX	STDEV		N
2000	0	57108	952336.16	263713434	9495172.66		883
2001	0	97108	1454374.54	403507439	14446714.62		883
2002	0	164987	2047426.02	565744059	20281385.17		883
2003	0	245627	2915543.59	818662949	29039050.38		883
2004	-146	362089	4419077.24	1353213846	47909918.25		883
2005	0	511867	6384926.37	1859360124	65841805.38		883
2006	0	678310	9718347.31	2640092475	94024214.18		883
2007	0	934549	14955330.96	3988641545	143567227.08		883
2008	0	933413	20695500.55	5331899713	199305266.26		883
2009	0	1062812	20362727.51	5158029273	194335006.45		883
2010	0	1335574	23350184.98	5714300721	214781884.20		883
	Net Income						
	MIN	MEDIAN	MEAN	MAX	STDEV		N
2000	-13988946	2504	31360.28	16466352	751669.39		883
2001	-87733	3361	64291.39	21743744	773699.55		883
2002	-59342	4503	103628.28	36015985	1302838.45		883
2003	-60280	6208	131542.83	38816378	1404784.20		883
2004	-198128	8159	138373.48	43670882	1547516.06		883
2005	-7477664	11119	197315.98	62929968	2269901.74		883
2006	-63271	14834	289182.41	87868870	3107099.48		883

2007	-608622	16806	340970.61	116684723	4060316.11		883
2008	-9406077	16045	303962.37	109939802	3913336.89		883
2009	-13561314	12380	84047.58	23751846	1494925.98		883
2010	-50125793	15391	362784.41	173978563	6344705.95		883
	Current ratio						
	MIN	MEDIAN	MEAN	MAX	STDEV		N
2000	0.00	1.79	5.10	1515.50	52.81		883
2001	0.00	1.87	7.25	1100.50	58.37		883
2002	0.00	2.44	101.97	74395.03	2517.19		883
2003	0.00	2.40	6.85	1962.85	69.68		883
2004	0.00	2.44	18.56	12883.28	433.66		883
2005	0.00	2.36	31.25	24910.61	837.74		883
2006	0.00	2.26	76.73	65073.86	2188.57		883
2007	0.00	2.24	52.29	43310.62	1456.62		883
2008	0.00	2.28	141.43	122113.00	4107.01		883
2009	0.00	2.27	51.45	42116.38	1416.51		883
2010	0.00	2.23	22.86	15779.60	532.50		883
	Debt to Equity (D/E) ratio						
	MIN	MEDIAN	MEAN	MAX	STDEV		N
2000	-47.28	3.00	4.71	103.87	8.23		883
2001	-12.55	3.01	4.58	145.01	8.05		883
2002	-1.97	3.35	4.85	99.92	6.56		883
2003	0.00	4.00	5.74	259.91	12.68		883
2004	0.01	3.97	5.88	349.71	15.10		883
2005	0.02	4.81	6.02	86.46	5.87		883
2006	0.07	5.62	6.88	122.97	7.88		883
2007	0.01	5.75	6.62	146.04	6.80		883
2008	-162.57	4.79	5.44	65.84	7.63		883
2009	-6.51	4.43	5.57	416.55	14.52		883
2010	-5.35	4.99	5.95	184.53	7.48		883
	Return on Assets (ROA)						
	MIN	MEDIAN	MEAN	MAX	STDEV		N
2000	-1.06	0.02	0.03	0.34	0.06		883
2001	-0.32	0.01	0.02	0.40	0.04		883
2002	-0.22	0.01	0.02	0.55	0.04		883
2003	-0.74	0.01	0.02	0.39	0.04		883
2004	-0.15	0.01	0.02	0.31	0.02		883
2005	-0.17	0.01	0.02	0.29	0.03		883

2006	-0.53	0.01	0.02	0.27	0.03		883
2007	-1.01	0.01	0.02	0.36	0.04		883
2008	-0.63	0.01	0.01	0.64	0.04		883
2009	-1.20	0.01	0.01	0.23	0.06		883
2010	-0.63	0.01	0.01	0.15	0.04		883
	Return on Equity (ROE)						
	MIN	MEDIAN	MEAN	MAX	STDEV		N
2000	-16.37	0.08	0.11	1.46	0.59		883
2001	-0.48	0.06	0.11	1.55	0.15		883
2002	-0.75	0.07	0.12	1.59	0.16		883
2003	-1.14	0.08	0.12	1.77	0.16		883
2004	-0.27	0.07	0.10	0.66	0.09		883
2005	-1.28	0.08	0.10	0.92	0.11		883
2006	-0.79	0.09	0.11	0.63	0.10		883
2007	-1.19	0.08	0.11	0.74	0.11		883
2008	-3.57	0.06	0.11	30.76	1.05		883
2009	-2.03	0.04	0.07	25.31	0.87		883
2010	-6.12	0.04	0.03	0.85	0.28		883

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